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CANADA

DEPARTMENT OF MINES

SIR JAMES LOUGHEED, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

GEOLOGICAL SURVEY

W. H. COLLINS, DIRECTOR

Summary Report, 1920, Part C

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STORAGE

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1921

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Department of Mines

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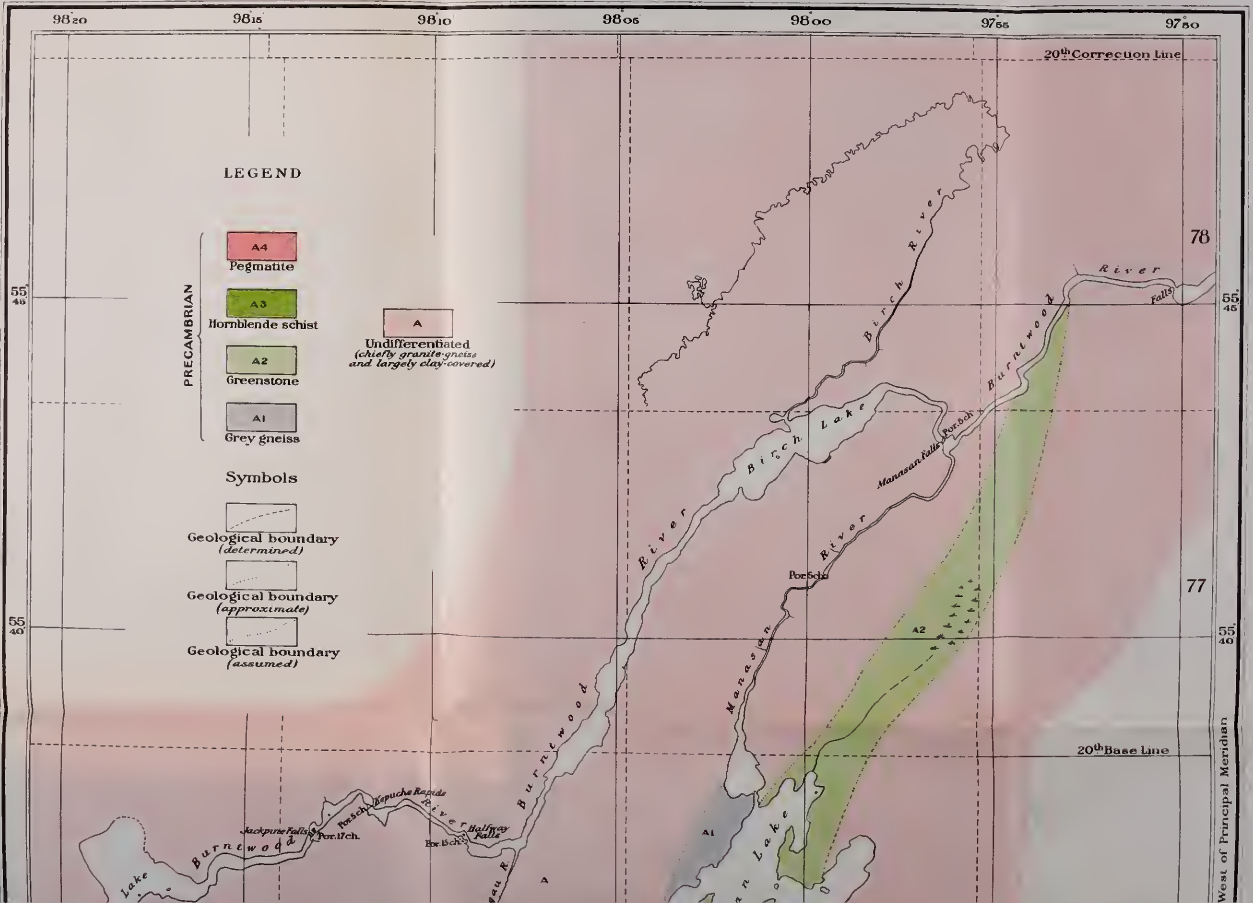
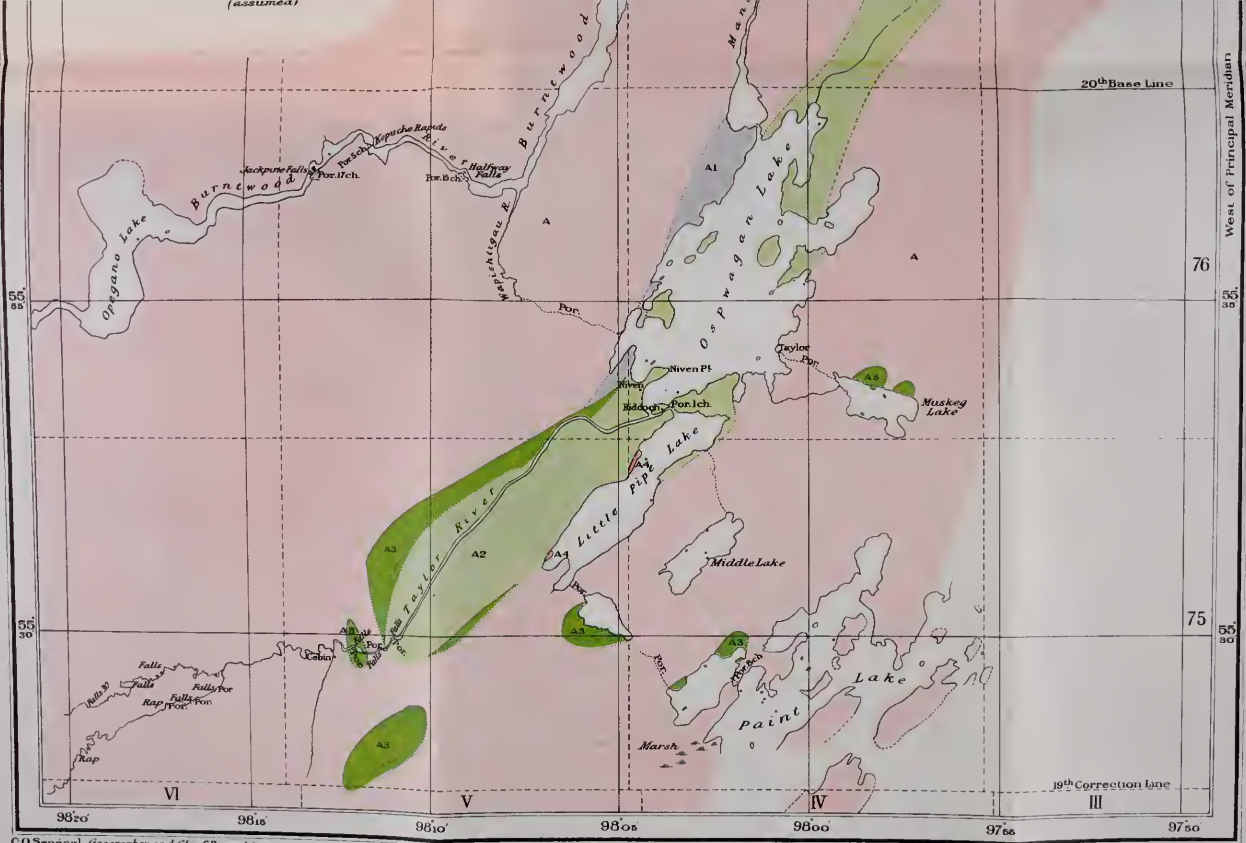
GEOLOGICAL SURVEY

W H Collins, Director

Issued 1921





C.O.Senécal, *Geographer, and Chief Draughtsman.*
A.S.Jost, *Draughtsman*

Publication No 1861

THE OSPWAGAN LAKE-BURNTWOOD RIVER AREA, MANITOBA.

To accompany Report by F.J.Alcock.
in Summary Report, Part C. 1920

Scale of Miles

1 ½ 0 1 2 3 4 5 6 7 8 9

SUMMARY REPORT, 1920, PART C

THE OSPWAGAN LAKE–BURNTWOOD RIVER AREA, NORTHERN MANITOBA

By F. J. Alcock

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Map 1861. The Ospwagan Lake-Burntwood River area, Manitoba 1C

INTRODUCTION

The geological mapping of the Ospwagan[1] Lake-Burntwood River area was undertaken during the field season of 1920. This area is one of the prospecting fields of northern Manitoba, in which rocks other than granite and granite gneiss were known to occur. Assistance in the field was rendered by A. L. Ham, of the University of Manitoba, and by A. K. McGill, of Queen's University. During two months, while the writer was making a trip to the Seal River country, topographical and geological mapping was continued in the area under the charge of Mr. Ham. The method of survey was by means of Rochon micrometer and surveyor's compass with telemeter surveys substituted on portages and winding streams. Away from the canoe routes geological mapping was performed by means of pace and compass traverses. The control for the accompanying map of the area is part of a transit and stadia survey made during the past field season by Mr. E. P. Bowman, of the Department of the Interior. Thanks are due to Mr. P. H. Taylor, of Thicket Portage, for the use of his cabin on Ospwagan lake as a central camp for the season. Thanks are also due to Mr. Geo. Cowan and Mr. Thos. Riddoch for courtesies extended to the writer.

POSITION OF AREA AND MEANS OF ACCESS

The Ospwagan Lake-Burntwood River area lies in approximate latitude 55° 30′ and approximate longitude 97° 30′ west. Its length in a north and south direction is 25 miles; its width in an east and west direction is approximately 20 miles; its area is, therefore, 500 square miles.

The nearest point on the railway is Thicket Portage or Mile 185 on the Hudson Bay railway. Train service is maintained once every two weeks over this line from the town of The Pas as far as Mile 214.

From Thicket Portage a canoe route leads direct to Ospwagan lake. The first part consists of about 15 miles on Wintering lake around a long point which stretches northeastward into the lake. A winding creek which enters Wintering lake from the west is then ascended to the first portage. This portage has a length of 53 chains and leads to a small narrow lake extending in a northeast direction. From the northwest side of this lake a portage 1 mile and 13 chains in length leads to Paint[1] lake, an expansion of Grass river. The route crosses Paint lake between a number of islands to a bay on its northwest shore. A short portage of 8 chains leads over a clay bank to a small lake, and from the opposite side of this lake the second long portage on the route begins. This has a length of 1 mile and 10 chains and leads to another small lake. A fifth portage with a length of 30 chains reaches Ospwagan lake.

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[1] Formerly Pipe or Pipestone. Cree name meaning "pipe."

Ospwagan lake consists of two parts, a southwestern portion about 4 miles in length, known as Little Pipe lake, and a northeastern about 5 miles in length, the two connected by a short, winding, sluggish stream. From Ospwagan lake the route to Nelson House for loaded canoes is down Manasan river to where it joins the Burntwood and from there up the latter stream. Light canoes coming from Nelson House usually make a 2½-mile portage from Wapishtigau river into a bay on the western side of the north half of Ospwagan lake. This portage crosses wet muskeg country but it saves a distance of over 20 miles.

HISTORY

The general history of the Ospwagan Lake-Burntwood River area has been discussed in the report on the Rat River route from Threepoint lake to Southern Indian lake, which accompanies the present report. Forming part of the regular route from Thicket Portage to Nelson House it was mapped in 1793 by David Thompson. In 1896 J. B. Tyrrell traversed the route, mapped it, and reported on the geology of the area. The more recent history of the region is in its connexion as one of the prospecting fields of northern Manitoba. The greenstone rocks which outcrop along the shores of Ospwagan lake have been prospected many times within the last few years and a number of claims have been staked. Some of these are on small quartz veins, and more recently a claim was staked on the west shore of Ospwagan lake for sulphides. Very little work, however, has been carried out on any of the claims.

GENERAL CHARACTER OF THE DISTRICT

Topography

The area presents the usual type of topography displayed by the Precambrian belt of northern Manitoba. Ospwagan lake has an elevation of 510 feet above sea-level. The surrounding country rises to an average elevation of from 50 to 100 feet above this. Northwest of Ospwagan lake one ridge reaches an elevation 175 feet above the lake. Along the northwest shores of both parts of Ospwagan lake the rise is abrupt and the adjacent hills appear higher than they really are. From the top of the ridges the country presents the usual monotonous character of low, rounded, hummocky ridges separated by depressions occupied by muskeg swamps or by wooded, flat, clay-covered areas.

Drainage

Ospwagan lake drains by means of Manasan river into the Burntwood. A few small streams enter the lake. The most important of these is Taylor river from the southwest, which enters Ospwagan lake near the narrows between it and Little Pipe lake.

The part of Burntwood river included in the area contains a fall known as the Manasan where the river breaks directly across the strike of vertically-standing gneiss. The drop is approximately 25 feet, and should waterpower ever be required in the area, this would serve as a ready source.

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[1] Formerly Manuminian Indian word meaning "paint."

Population

There are no settled inhabitants of the area. There are several cabins on Ospwagan lake which have been used for winter trapping by traders who pass through the area and by men who have prospected in the region, but their use has been only temporary. There are even no Indians who make the area their permanent hunting field.

GENERAL GEOLOGY

The rocks of Ospwagan Lake-Burntwood River area are all of Precambrian age. They consist of a belt of greenstone and tuffaceous rocks forming a narrow fringe on either side of Ospwagan and Little Pipe lakes and extending northeastward to Burntwood river. These greenstone rocks have been to a large extent altered by granite intrusions into hornblende schists. Along the east shore of Ospwagan lake is a border contact zone of mixed granite and greenstone. On the west shore of the lake is a band of sheared gneiss which resembles a granite gneiss, and another belt to the west consisting of finely-banded, dark grey gneiss whose appearance is suggestive of a sedimentary origin. Though the structure is vertical the relative positions of the greenstone and grey gneiss belts suggest that the latter underlies the former, a sequence corresponding to that of the Karsakuwigamak area given in the description of the Rat River route. Along Burntwood and Birch rivers are outcrops of grey garnetiferous gneiss. Some of these may represent metamorphosed sediments, but the majority of those along the Burntwood have the general appearance of igneous gneisses. Whether they represent intrusive gneisses older than the regional granite or merely the differentiated parts of the regional granite which have been altered by the assimilation of sediments or volcanics is difficult to determine. They differ in appearance from the reddish granite but, owing to the heavy mantle of clay, outcrops are confined to the shores of the lakes, to local outcrops along the streams, and to the summits of the higher ridges, which makes the determination of actual relations difficult.

Grey Gneiss

Lying immediately west of the northern part of Ospwagan lake is a ridge containing the highest point in the area. The rock consists of a dark grey, finely-banded gneiss which is striking in a direction north 30 degrees east. It is uniformly fine-grained and its foliation planes stand vertically. In thin section the following minerals are seen to be present: quartz, orthoclase, albite, hornblende, biotite, chlorite, iron ore, apatite, and tourmaline. Quartz is the most abundant mineral, and of the feldspars orthoclase is considerably in excess of the plagioclase. The hornblende is partly altered to chlorite. The biotite is brown in colour and is less abundant than the hornblende. Iron ore and apatite are fairly abundant as accessory minerals and one fragment of tourmaline was observed in one section. The rock is crushed and altered and its original character is difficult to determine.

A somewhat similar rock, which is merely on the same strike, outcrops at Manasan falls on Burntwood river. The rock is here an extremely well-banded, dark grey gneiss striking north 52 degrees east and with vertical foliation planes. The fine individual bands can be traced for considerable distances and the appearance is suggestive of a sedimentary origin. It contains, however, numerous small pegmatitic stringers. Under the microscope it resembles very much the rock already described.

Along the west shore of the northern part of Ospwagan lake, east of the high ridge of grey gneiss already described, is a narrow belt of light grey rocks with foliation planes striking northeast parallel to the shore of the lake. Though the rocks are dominantly white or grey in colour, in some there is a colour banding due to the presence of parallel dark streaks. The rocks are dense, fine-grained types;

they are distinctly foliated, with locally a distinct fracture cleavage developed. In places they look like mashed grey granites; other finer-grained specimens have the appearance of sheared acid porphyries, such as are present in some of the other Precambrian areas of northern Manitoba. In thin section they are seen to consist mainly of quartz and orthoclase with some microcline and plagioclase in certain sections; brown biotite and altered green hornblende are both present in subordinate amounts and a little iron ore and apatite. The rocks are so different from the regional reddish granite outcropping close to them that they have been mapped with the pre-granite complex. They may represent either older intrusives or re-fused acid tuffs.

A type of gneiss outcropping along Birch river is a light grey variety containing abundant garnets. In thin section the following minerals are found: quartz, orthoclase, plagioclase, biotite, and garnet. The quartz occurs as large, irregularly-shaped grains, some of which show undulatory extinction. The biotite occurs abundantly in long shreds. It is pleochroic in shades of from light yellow to dark brown. Nearly all have a parallel arrangement of their longer directions. The garnet masses are irregular in shape and contain considerable amounts of quartz and some biotite They lie directly across the biotite shreds and, evidently, have been developed later than the foliation of the rock. Some apatite and one fragment of zoisite are present in the section studied.

Greenstone

A narrow band of greenstone outcrops on both the east and the west shores and the islands of Ospwagan lake. The typical rock is a dense, massive, black variety. In thin section it is seen to be highly altered, consisting largely of chlorite with minor amounts of altered feldspar, some iron ore, and calcite. The rocks apparently represent basic volcanic flows.

Tuffs

On some islands west of Nivens point are small finely banded dense black rocks associated with the more massive greenstone types. These are considered to be basic tuffs. They occur, however, only in subordinate amounts in the area.

Hornblende Schist

The greenstone belt of Ospwagan Lake area is so narrow that the intrusions of granite have affected practically the whole belt of the pre-granite complex. The common product of the contact metamorphism of the greenstone rocks by the intrusive granite is hornblende schist, and in fact about half of the volcanics of this belt may be described as hornblende schists. In the areas underlain largely by granites are also to be found small patches of this schist which represent either engulfed greenstone masses or roof pendants. Examples of the latter type are seen on Muskeg lake, and on one of the small lakes on the portage route between Ospwagan and Paint lakes.

The rocks vary considerably in appearance and size of grains. On Muskeg lake the schist is black and glistening with individual hornblende crystals up to one-quarter of an inch in length. In other places the rock is dense with fine needles of hornblende just visible to the naked eye. In thin section the dominant mineral present is seen to be green hornblende. As a rule it amounts to over 50 per cent of the rock. It is sometimes altered to chlorite. The rest of the rock is made up of quartz, feldspar, including both orthoclase and plagioclase, and minor amounts of iron ore, either magnetite or pyrite. In some sections calcite is present in considerable quantities and at one point on the Burntwood below Ospwagan lake the hornblende schist contains masses of a grey carbonate and is traversed by similar narrow stringers which are apparently an alteration product of the schist.

On the south shore of the first small lake east of Ospwagan lake, on the portage route to Paint lake, is a fringe of hornblende schist. In places the rock is well banded, suggesting a metamorphosed tuff. The harder bands locally stand up as little ridges above the softer, most schistose bands. At one point where there is an actual intrusive contact between the basic rock and the massive red granite, the basic rock is seen to contain bunches of red garnets. The banding and schistosity are both parallel to the contact. An interesting feature in connexion with this particular outcrop of hornblende schist is the presence of flakes of graphite throughout it. Certain hand specimens show flakes up to ¼ inch in diameter abundantly scattered throughout the rock. In thin section minor amounts of reddish brown biotite are also seen to be present.

Granites

The granite throughout the area varies in colour from grey to red and from massive to gneissoid types. Along the borders of the intrusions porphyritic varieties are locally developed. The principal variety is a reddish, massive type locally showing a banded arrangement of the ferromagnesian minerals. The commonest variety from a mineralogical point of view is that in which biotite is the dominant dark-coloured mineral. The feldspars include orthoclase, microcline, and albite, of which orthoclase is the most abundant. Quartz is abundant in all the sections, and as a rule shows undulatory extinction. Accessory minerals include apatite, iron ore, and zircon. In many of the sections the feldspars are partly altered to kaolin and the biotites to chlorite.

Along the east shore of Ospwagan lake the contact between the greenstone and the granite is marked by a border zone which differs to a considerable extent from the granite away from the contact. This contact zone in places consists of dark-weathering gneiss, irregularly banded, traversed by many small white and reddish stringers of pegmatite. In other places the zone is marked by numerous inclusions of greenstone. These inclusions are frequently long and narrow and locally make up a considerable percentage of the rock. They are to a large extent altered to hornblende schist. At other places the granite at the contact is coarsely porphyritic with large white and pink feldspars in a fine-grained, grey matrix. The contact zone is further marked by numerous aplite and pegmatite dykes. Some of the border phases of the granite gneiss and a few of the pegmatite dykes themselves were found to be garnetiferous.

Gabbro

Cutting the granite gneiss on Wintering lake are dykes of a dark, massive, black rock which under the microscope proves to be a gabbro. The principal mineral is an altered monoclinic pyroxene, which occupies about three-quarters of the section studied. Olivine is also present as large rounded fragments; considerable amounts of dark brown biotite; and a little iron ore. Plagioclase is present in only minor quantities and only part of it is striated. These gabbro dykes appear to be the youngest intrusions of the area. Other dense, fine-grained types which are apparently diabases are considered to be related to them.

Pleistocene and Recent

Much of the area is covered by clay. Part of this is glacial till but the most of it is of post-glacial age laid down in a glacial lake which covered the region after the retreat of the ice. In places there are wide areas of level clay land in which for long distances no rock outcrops. These belts support an open forest of spruce, jackpine, and poplar, and if the climate permitted would prove to be of agricultural importance when means of transportation are improved. Many of the depressions, however, are poorly drained and as a result are occupied by muskeg swamps.

ECONOMIC GEOLOGY

The area has been prospected a number of times, but, as yet, nothing of importance has been discovered. The heavy mantle of clay confines prospecting efforts to the immediate shores of the lakes and the summits of the ridges. In addition to this the greenstone belt is extremely narrow so that as a prospecting field it can not be said to be attractive. A number of claims have, however, been staked along Ospwagan lake. Some of these are on small quartz veins traversing greenstone. One south of Nivens point is staked on a rusty zone in greenstone. The mineralization consists of pyrite, pyrrhotite, and some chalcopyrite in a shear zone about 2½ feet in width. A little work has been done on this claim but insufficient to show the extent of the mineralized zone.

RAT RIVER ROUTE FROM THREEPOINT LAKE TO SOUTHERN INDIAN LAKE, MANITOBA

By F. J. Alcock

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General geology 10c
Economic geology 12c

Illustration

Map 1838. Rat River route from Threepoint lake to Southern Indian lake, Manitoba 6c

INTRODUCTION

Rat river forms the canoe route regularly used by the Nelson House Indians who trap in the country surrounding Southern Indian lake. The accompanying map (No. 1838)—the first to be made of the route—is the result of a track survey performed during the field season of 1920. The bearings are from compass readings; the distances were obtained by taking the time of canoe travel between sketching points, checked by numerous sextant readings for latitude. Considerable information about the country was obtained from trappers and traders at Nelson House and from local Indians.

The Rat River route lies in a general way along longitude 99° 15′ west. The latitude of the mouth of Rat river where it enters Threepoint lake is 55° 40′, and that of Southern Indian lake where it is entered from the canoe route is 50° 40′.

The nearest railway point is Mile 185 on the Hudson Bay railway. A bi-weekly train service is maintained over the line from the town of The Pas as far as Mile 214. From Mile 185, or Thicket Portage, a canoe route leads across Wintering and Paint lakes to Ospwagan lake from which the Manasan river is descended to the Burntwood. Between Wintering and Ospwagan lakes there are five portages, two of which are each over a mile in length. On Manasan river there is one short portage. On the Burntwood, between the mouth of Manasan river and Threepoint lake, there are nine falls which necessitate portaging, besides a number of rapids which can be run but which require tracking or portaging in ascending the river. The portages, however, are mostly short, the longer ones having lengths of about 15 chains. Three

Canada
Department of Mines

Hon Sir James A. Lougheed, Minister Charles Camsell, Deputy Minister

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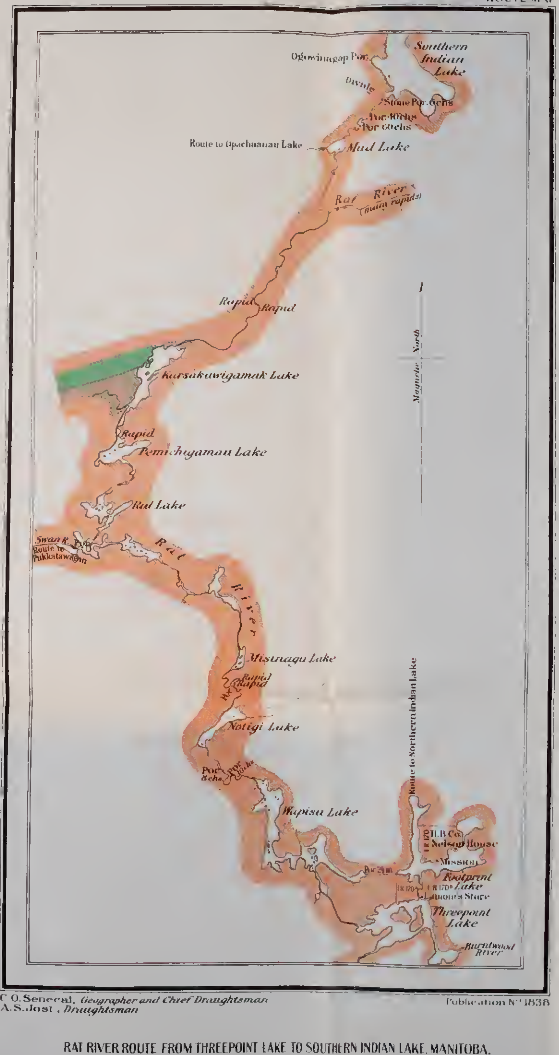
ROUTE MAP

LEGEND

▨ Granite and granite gneiss

🟩 Volcanic flows and pyroclastics

▨ Sedimentary schists and gneisses



C. O. Senecal, *Geographer and Chief Draughtsman*
A. S. Jost, *Draughtsman*

Publication No. 1838

RAT RIVER ROUTE FROM THREEPOINT LAKE TO SOUTHERN INDIAN LAKE, MANITOBA.

Scale of Miles

10 5 0 10 20

To accompany Report by F. J. Alcock
in Summary Report, Part C 1920

Surveys and Geology by F. J. Alcock, 1920

point lake is the meeting point of three rivers, the Burntwood from the west, the Rat from the northwest, and a sluggish stream 2 miles in length draining Footprint lake. Nelson House is situated on Footprint lake.

An alternative route to Nelson House from the Hudson Bay railway begins at Mile 137. From here canoes follow Setting lake and Grass river as far as Paint lake and thence over the route already mentioned to Threepoint lake. Still another route leads from the northwest shore of Setting lake and joins the Burntwood at the south end of the lake expansion known as Wuskwatim lake. This route crosses a number of lakes and since some of the portages connecting them are long, loaded canoes never follow it. The regular winter trail, however, follows this route.

The history of the region is to a large extent the history of the fur trade. In the year 1670 the Hudson's Bay Company were granted their charter by King Charles II and trading posts were soon established at the mouths of the important rivers which flow into Hudson bay. For a long time, however, the company was content to allow the Indians to bring their furs to the coast forts, and as long as they continued to do so no attempt was made to explore the country inland. The only exception to this was by Henry Kelsey, who in 1691 with some Indians travelled inland from York Factory at the mouth of Hayes river, but whose descriptions of his wanderings are so vague that it has never been agreed where he actually did go. It has been thought that a place he refers to as Deerings Point is really Split lake, where the Burntwood joins the Nelson. He mentions ascending a river from this point for a distance of 71 miles and this is believed to be the Burntwood.

The French at Montreal and Quebec also found the fur trade profitable, and their traders and explorers in time followed the natural waterways as far west as lakes Winnipeg and Manitoba. They also ascended the Saskatchewan river to the forks, and crossing overland to the Missouri ascended it to the foothills of the Rocky mountains.

With the transfer of Canada to Great Britain in 1763 there came to Quebec and Montreal a large number of English-speaking merchants, the majority of them of Scottish descent. They soon became interested in the trade in furs and it was not long before they had rediscovered the old French canoe routes to the west. They were so successful in intercepting the Indian fur brigades on their way to York Factory that it became necessary for the Hudson's Bay Company to establish inland posts. The first of these was at Cumberland, established in 1774 by Samuel Hearne. In 1784 the various Montreal companies united into one strong organization known as the North-West Company. From this time onward it became a race between the two great rivals, one with its headquarters on Hudson bay and the other with its headquarters at Montreal, which should extend its operations the farthest.

The Canadian traders from Montreal were the first into the Burntwood River country. Their route was down Nelson river from lake Winnipeg to Sipiwesk lake, over Cross portage into Landing lake, and thence across Thicket portage to Wintering lake, from which it was easy to reach the Burntwood along the route which is still the one used today.

In 1793 the Burntwood was ascended by a Hudson's Bay Company's surveyor. On September 5, 1792, David Thompson left York Factory, and ascended Nelson river as far as Sipiwesk lake. Here he built a post and passed the winter. In the spring he traversed Cross portage, surveyed Landing lake and entered Wintering lake, then known as Chatham lake. Here on a long point extending northward into the lake the company had a trading post known as Chatham House. From Chatham House Thompson carried his survey across Paint and Ospwagan (Pipe) lakes and up the Burntwood to Duck portage, where he crossed over into the Churchill River waters. He ascended the Churchill for a distance of 33 miles, returning down the Burntwood to Split lake, and from there down the Nelson to York factory. His notes give a minute description of the routes, with lengths of portages, what rapids can be run, and many other details. Thompson altogether spent six years in the general region of Burntwood and Grass rivers; during four of these, 1792-1796, he was in the service of the Hudson's Bay Company; the other two, 1804-1806, were spent in the employ of the North-West Company. In 1814 Thompson compiled his various surveys into a map of the Northwest Territories, the original of which is now in the Crown Lands office, Toronto. This served as a basis for all the general maps of the region until the work of Tyrrell and Dowling, performed in 1896 and 1899, was published.

In the summer of 1896 J. B. Tyrrell made a survey of the lower part of Burntwood river. The route followed was from Sipiwesk lake on the Nelson, across Landing, Wintering, Paint, and Ospwagan lakes and up the Burntwood to Nelson House.[1]

In the summer of 1899 D. B. Dowling made surveys of the upper part of the Burntwood from Threepoint lake to its head near Reed lake.[2]

GENERAL CHARACTER OF THE DISTRICT

Topography

The area drained by Rat river is part of the Precambrian plateau of Manitoba, which here has an average elevation of about 800 feet above sea-level. Its two main characteristics are those which prevail over the whole plateau, low relief and disorganized drainage. As a rule the country rises to a height of 50 or 100 feet above the level of the adjacent lakes, but in places the difference in relief is greater than this. On either side of Notigi and Misinagu lakes, ridges of red granite rise to a height of 200 feet above the river. From the top of these ridges the country presents a monotonous appearance. The skyline everywhere shows a regularity approaching that of the sea. Though the surface as a whole is so flat, in detail it exhibits a rough hummocky appearance with low hills and ridges separated by minor depressions often occupied by small lakes or muskeg swamps. The tops of the ridges consist as a rule of practically bare rock supporting a sparse growth of small spruce. Along the lakes and streams the topography has been considerably smoothed out by the deposition of clay.

Drainage

The only important stream of the area other than the Burntwood is Rat river itself. An interesting feature in connexion with it is the fact that the divide between its waters and those of Churchill river to the north is at the immediate shore of Southern Indian lake. A portage 6 chains in length, known as Stone portage, leads from a lake, the headwaters of one of the branches of Rat river, across a low rock ridge to one of the bays of Southern Indian lake. The canoe route from Threepoint lake follows the main Rat river most of the way. Between Karsakuwigamak (Narrow) and Mud lakes, however, the main Rat river is left and a smaller western branch is ascended to Stone portage. The main Rat river, above the junction of the two branches, drains the country southeast of Southern Indian lake. It is reported to be marked by many rapids. The other streams of the area are small. Of these, Swan river, the most important, forms part of a canoe route to Pukkatawagan, a route, however, marked by several long, wet portages. Another canoe route, sometimes used, follows a stream which enters Mud lake from the west. This route leads to Opachuanau lake on Churchill river south of Southern Indian lake, and is sometimes used by Nelson House traders as a route to Southern Indian lake before that lake is free of ice.

Rat river is the regular route followed by the Nelson House Indians to their hunting grounds around Southern Indian lake. Nearly every good camping site along its course is marked by tepee poles. As a rule the trip one way occupies about six days As canoe routes go in this part of the country it is an excellent one. Over 50 per cent of the distance consists of lake expansions and in the intervening stretches the current is only locally swift, and the portages are few and comparatively short. The most difficult part of the route is at its northern end where the branch of Rat river followed is narrow, winding, and overgrown with willows, and where the two longest portages on the route are situated, with lengths of 60 chains and 40 chains respectively.

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[1] Tyrrell, J. B., Geol. Surv., Can., Ann. Rept., new ser., vol. XIII, 1900, p. 32 F.

[2] Dowling, D. B., Geol. Surv., Can., Ann. Rept., new ser., vol. XIII, 1900, p. 26 FF.

The lake expansions of Rat river vary in width up to about 4 miles. The longest is Karsakuwigamak with a length of approximately 10 miles. The shores consist of bare rocks, rock cliffs, or morainal boulders or clay. Outcrops are abundant. Along the stretches of the river between the lake expansions the banks are for the most part of clay. Here and there, however, and at most of the rapids, outcrops are found. The two portages of 40 and 60 chains are over clay where no rock is exposed; the last portage, Stone portage, is over granite gneiss. Along some of the smaller streams, as for example the one entering the southern end of Karsakuwigamak lake from the west, clay banks in places rise to a height of 30 feet.

The height of the water varies greatly throughout the seasons and from year to year. On descending the river in August the water was considerably lower than when the stream was ascended in July. A dominant high-water mark on the rocks and trees along the banks stands at an elevation of about 7 feet above the ordinary summer level; this is the result of a recent high spring flood.

Industries and Resources

The gathering point for the inhabitants of the region is Nelson House, where there are an Indian reservation, a Methodist mission and a Roman Catholic mission, a Hudson's Bay Company post, and several other stores. The greater part of the population, however, although they come to Nelson House to trade and gather there for treaty in July, spend most of their time away in their hunting grounds. A large number go to Southern Indian lake over the Rat River route. Trapping is the main industry and a large quantity of furs is annually brought in to Nelson House. Small branch posts are now maintained also by several traders on Southern Indian lake at the narrows, about 10 miles north of Stone portage.

Fish and game form the main sources of food. Of game animals moose and caribou are the most important. Fishing is carried on only for local consumption. Garden vegetables of various kinds are raised in considerable quantities at Nelson House.

The timber over most of the area is small. Along the streams are locally found good groves of white spruce and also poplar and white birch. The most abundant tree of the region is, however, small black spruce.

GENERAL GEOLOGY

The rocks exposed along Rat river consist of Precambrian granites and gneisses with one small area of an older complex of sediments and volcanics, the whole covered to some extent by deposits of Pleistocene clays.

Table of Formations

Quaternary	Recent Pleistocene	Peat Lake clays Boulder clay	
Great unconformity			
Precambrian.	Gabbro and diabase dykes		
	Igneous contact		
	Pegmatites and quartz veins Granite, granite gneiss, etc.		
	Igneous contact		
	Pre-granite complex	Upper Division	Quartz porphyry and lamprophyre. Volcanic flows and pyroclastics.
		Lower Division	Mica schist. Paragneiss.

Pre-granite Complex

The pre-granite complex consists of a series of sediments and volcanics exposed on the western shore of Karsakuwigamak lake. The belt runs in a northeast direction and pinches out immediately north of the lake. The greatest width of the belt is about 5 miles. The distance to which it runs west of the lake was not determined, but it extends for at least 6 miles in this direction. The complex consists of two divisions, a lower sedimentary and an upper igneous. The sedimentary part consists of finely-banded gneisses and schists, and the igneous of dark volcanic flows and pyroclastics, locally altered to hornblende schist and intruded by light-coloured porphyry and dark-coloured lamprophyre dykes.

Lower Division

Paragneiss. The paragneiss is a fine-grained, mainly light-coloured grey rock. Broken along its foliation planes, black patches of biotite are locally abundant. In thin section the rock is seen to consist mainly of quartz in the form of small rounded or subangular grains. Larger masses of interlocking quartz crystals are also found in the sections. Feldspar is present and consists of orthoclase. Small flakes of greenish-brown biotite are also found in considerable quantities. They show great uniformity in their orientation. Sericite occurs in some sections and a few grains of magnetite and pyrite are usually to be found.

Mica Schist. Structurally overlying the grey gneiss is a belt of dark-coloured schists. They are uniformly fine-grained and in some hand specimens fine glistening needles of hornblende can be recognized. The most common type is a biotite schist consisting of brown biotite, fine-grained quartz, with subordinate amounts of feldspar. In some sections larger crystals of green hornblende are present most of which lie in the plane of foliation but a few of which cut across it. Near the granite contact at the southern end of Karsakuwigamak lake the schist contains considerably more hornblende than biotite. In places, light-coloured, quartzite-like bands are interlaminated with the darker coloured schists, forming the main field evidence for the sedimentary origin of the series. These bands vary in width from less than an inch to over a foot in thickness.

Upper Division

Greenstone. The greenstone rocks lie west of the belt of sedimentary schists and gneisses; they outcrop on the western shore of Karsakuwigamak lake near its northern end. The sediments everywhere dip underneath the volcanics and hence the latter have been placed above them stratigraphically. The main variety of volcanic is a green to black rock which in thin section is found to be highly altered, consisting of a mass of secondary minerals among which chlorite, pale green hornblende, and calcite are prominent. The rocks locally show a banded structure due to flow, and in places ellipsoidal structure was observed. Lighter coloured, oval-shaped areas also occur in the greenstone rocks and often the centre of these patches consists of green-coloured material of which the prominent mineral is epidote.

Pyroclastics. Associated with the massive greenstone flow rocks are bands consisting of large and small fragments of similar material which are considered to be of pyroclastic origin.

Porphyry. Dense, acid rocks varying in colour from white to light grey, sometimes with a reddish tint, are also found associated with the more basic types. Many of them follow the structure of the greenstone rocks, but some are clearly dykes which cut across them. In thin section the rock is seen to consist largely of fine quartz and orthoclase, with small amounts of brown biotite and a considerable quantity of secondary sericite and calcite. A few large crystals of quartz are present and grains of pyrite are fairly abundant.

Lamprophyre. Cutting the greenstone rocks west of Karsakuwigamak lake are several small dykes of fine-grained, black rock which belong to two varieties. In one the dominant mineral is a dark green hornblende associated with which are minor amounts of olivine, orthoclase feldspar, quartz, and iron ore. In the other variety brown biotite in small shreds is the dominant ferromagnesian mineral. The dykes have an average width of about 2 feet and can be traced on an average for about 50 feet.

Granite and Granite Gneiss

Granite and granite gneiss is the rock which is exposed throughout nearly the entire part of the Rat River route. It shows considerable variation throughout the region, being in some places massive and in others gneissoid. The principal variety is a reddish, slightly gneissoid granite consisting of quartz, orthoclase, and brown biotite, with accessory iron ore and apatite.

Along the route are grey granite gneisses with an appearance quite different from the massive red granites. Some of these gneisses are garnetiferous. It is possible that they either represent older gneisses or that they are differentiated phases formed by the absorption of the older intruded rocks.

The granite in immediate contact with the pre-granite complex west of Karsakuwigamak lake at one point shows a dark border zone. In thin section this border rock is seen to contain considerable quantities of hornblende. At other places where the actual intrusive contact was observed the granite shows no evidence whatever of assimilation.

Gabbro and Diabase

A few small dykes of gabbro and diabase similar to those found in the Ospwagan Lake area were found cutting the granite gneiss on Rat river above Threepoint lake.

Pleistocene and Recent

The region is mantled with widespread deposits of clay. Along the lakes and streams sections of boulder clay are locally exposed. Overlying the boulder clay are dark-coloured clays containing no boulders, which are considered to be lake deposits, laid down after the retreat of the ice from the area. These clays extend up Rat river to Southern Indian lake. The deposits are confined to the valleys, the tops of the ridges being uniformly bare.

The direction of ice movement in Pleistocene times is given by the following striation bearings:

Rat river, mouth..	S. 30	degrees	W.
Rat river, 6 miles up..	S. 22	"	W.
Swan lake..	S. 29	"	W.
Notigi lake..	S. 33	"	W.
Pemichigamau lake..	S. 43	"	W.
Karsakuwigamak lake..	S. 42	"	W.

The Recent deposits consist of peat bogs in the undrained parts, of which owing to the general flatness of the region there are considerable areas.

ECONOMIC GEOLOGY

The only part of the region traversed which offers any hopeful chance as a prospecting field is the area underlain by the rock of the pre-granite complex along the western shore of Karsakuwigamak lake. In this area a number of quartz veins were observed but none of sufficient size to be of importance. The area also is small and much of the bedrock is concealed by the thick overburden of clay, so that as a prospecting ground the region cannot be considered as promising.

THE TERMINAL MORAINE OF THE SEAL-CHURCHILL DIVIDE

By F. J. Alcock

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GENERAL STATEMENT

The report brought out by trappers of high ridges of sand and gravel along Seal river north of Southern Indian lake in northern Manitoba created a rumour of possible placer deposits in this region and to investigate these reports the writer visited the country during the field season of 1920. The route followed was from Nelson House on Footprint lake north of Burntwood river to Southern Indian lake. A description of this route is given below. From the northern end of Southern Indian lake a canoe route across the Seal-Churchill divide was mapped and a sufficient portion of the Seal explored to determine the character of the surface deposits. A map on a scale of 6 miles to 1 inch accompanies the report (Map 1839). The method of surveying was by means of sextant readings for latitude, compass readings for bearings, estimation of distances by taking the time of canoe travel between sketching points, and sketches from prominent hills used as triangulation stations.

The country during the past few years has attracted several white trappers. A considerable number of martens are caught annually. Other fur-bearing animals include foxes, minks, beavers, otters, and muskrats. Bears and wolves are also numerous. Of game animals, moose and barren ground caribou are both found.

The region as far north as exploration was carried is forested. The chief types of trees are black spruce, white spruce, Banksian pine, birch, and poplar. The trees are small, however, and it is only at scattered points that groves of trees of sufficient sizes for good cabin construction are found. Banksian pine is proportionately less abundant than farther south. Even on the sand-plains, though fairly abundant, it is less common than the spruce.

DESCRIPTION OF ROUTE

The route to Seal river from Southern Indian lake leads from a bay at its northwest corner which stretches north from what is known as Bear narrows. On the older maps, the route is incorrectly shown as starting from an entirely different bay to the northeast. The river ascended is the Muskwesi or Grassy. For a distance of 5 miles from its mouth the stream is wide and sluggish with low grassy and marshy shores and islands. The main Muskwesi then swings to the southwest and a northern branch coming from Moss lake is followed.

Moss lake is a rectangular body of water with a northern arm and a western arm. Its greatest length is approximately 3 miles. Its shores are low, consisting of sandy beaches and morainal deposits. At its northern end a small outcrop of red granite is exposed on the western shore. Two streams enter the lake, a small creek from the west and Little Sand river from the north.

The mouth of Little Sand river is rather difficult to find. A narrow fringe of grass and willows separates the channel from the water of the bay on either side, and the river may be missed, easily, by ascending the bay either to the east or west of the channel. The river is winding. Its length from its source in Little Sand lake to Moss lake is approximately 22 miles; direct, however, the distance between the two lakes is about one-half of this. Its average width is about 30 feet. In high water there is only one portage, less than a chain, which crosses the neck of a small meander where there is a large log jam. In low water a number of log obstructions and shallow rapids full of boulders increase the difficulties of canoe travel. In the three weeks between the time of ascending the stream in July and descending it in August the water had lowered nearly 2 feet. The banks throughout are of clay and in places are high and steep. Along the river is a good forest growth with white spruce reaching a diameter up to 18 inches.

Little Sand lake at the head of Little Sand river lies in a north and south direction and has a length of 5½ miles. A winter trail runs south from it to a lake expansion at the mouth of Muskwesi river, crossing three small lakes along its course. Little Sand lake is shallow, with low shores, and its outlet is marked by a wide area of equisetæ. At its north end, however, a low ridge with an irregular crest stands out prominently, a ridge which here forms the divide between the drainage systems of the Seal and the Churchill. Immediately at the head of the lake the ridge reaches a higher elevation in the form of a hill which although it rises only 175 feet above the level of Little Sand lake stands out as a prominent topographic feature.

At the north end of Little Sand lake a small stream enters from the northeast, flowing from a lake about one-half mile long. The stream is too small for canoes and a portage 11 chains long leads along its north side to a point on the creek from which it can be followed to the lake. From a small bay on the western side of this lake a portage 12 chains in length crosses the sand ridge to a small lake on the Seal River side of the divide. A portage of 5½ chains is made from the opposite side of this lake to another V-shaped lake with two arms, each about 2 miles in length. The outlet is by the southern one of these arms into Trout lake. The canoe route, however, follows the northwest arm from whose western end a portage 27 chains long, known as Trout portage, leads across low muskeg country to Trout lake.

Trout lake has a length of 7 miles. It has low, irregular shores composed of morainal material supporting a dense growth of small spruce. Its outlet is to the north by way of Trout creek, a winding stream with no portage, but with many boulders which make canoe travel difficult in low water. From a bay about a mile west of the outlet of Trout lake a short portage route leads direct to Seal river. This route consists of two portages with lengths of 42 chains and 27 chains respectively, separated by a round lake about half a mile in diameter. This route is used more in the winter than in the summer, canoes as a rule following the longer route by way of Trout creek.

Seal river where joined by Trout creek has a width of over a quarter of a mile. Above this point it widens out and contains a number of low islands. The headwaters of this branch of the Seal is in Sand lake, a long, narrow body of water lying between Reindeer lake and Southern Indian lake. From Sand lake down to the mouth of Trout creek the current is reported to be swift with numerous rapids. Immediately north of the mouth of Trout creek a small lake expansion of the Seal receives a river from the north which may be ascended to where it cuts across a belt of sand ridge country similar to that north of Little Sand lake. From here the Seal flows northeastward between these two sandy belts.

Five miles below the mouth of Trout creek the river widens out into a large expansion known as Chipewyan lake. On its eastern side prominent sand ridges and hills stand out. One hill in particular, though but little higher than the rest, is separated from the main ridges and stands out as a prominent landmark which can be seen for miles. On the eastern shore of the lake expansion is an old Chipewyan Indian camping ground where numerous tepees and remains of canoe-building operations indicate a favourite stopping place. Below Chipewyan lake the Seal divides into two branches. The eastern flows through low-lying land; the western approaches the western sand ridge belt. Below the junction of the two branches the current, is swift, and canoe travel is excellent. As far as exploration was carried only one rapid was encountered and this was found capable of being run. In fact as far as Shethanei lake only one portage is reported to be necessary.

TOPOGRAPHY

In the part of Seal river explored, only one outcrop of bedrock was seen: everywhere else the country is covered with superficial deposits of boulders, gravel, sand, and clay. These deposits are in the form of sand-plains, sand ridges and hills, and irregularly scattered material. The relief is nowhere great. A few hills and ridges stand out prominently, but aneroid readings for elevations on all the higher ones showed that none rises more than 200 or at most 225 feet above the level of the river, and the majority have an elevation considerably less than this.

As already mentioned, the actual divide near Trout lake between the Seal and the Churchill waters is a narrow ridge running in a northeast direction. To the southwest of the portage it maintains its ridge-like character for a distance of 3 miles and to the northeast for a distance of 2 miles. It then fades out into rolling sandy country in which there is but little system to the hills. This narrow ridge is not uniformly straight but has a somewhat serpentine outline. Its sides are steep, making an angle of about 30 degrees to the horizontal at the angle of repose of sand. Its crest is narrow and though far from being uniformly level affords excellent walking. Well-marked trails show that it is a favourite path of the northern caribou. It is composed of clay, sand, gravel, and boulders, wholly unsorted. In places at the very top of the narrowest parts of the ridge are huge boulders some of which weigh tons. The characteristic rock type represented is red granite.

Where the ridge widens out into the broad, rolling, hilly country, there is no regular pattern or system to the hills. Depressions are numerous. Some of the hollows are perfectly dry supporting a growth of moss; others are wet and swampy and still others are occupied by lakes, many of which have no outlets. Some of the larger lakes, however, are drained by streams which have cut narrow channels through the sand ridges, show very irregular profiles, and are all marked by rapids.

The country east of Chipewyan lake displays similar features. The shore of the lake is bordered by a sand-plain. In places a steep cliff of sand cut by wave action forms the edges of the plain. The surface is either level or gently rolling. About half a mile from the lake, hills rising to a height of 200 feet have a general northeast trend, but there is no ridge as definitely pronounced as the one north of Little Sand lake. The summits of the hills are either bare or support only a sparse growth of spruce and white birch. From a distance these hills with their light-coloured ball tops stand out in sharp contrast to the rest of the sandy country with its spruce, jackpine, and birch forest.

Northwest of Seal river a similar type of topography obtains, with rolling sand-plains and more or less well-defined ridges with a dominant northeast trend. Between the ridges are numerous lakes some of which have outlets, but many which have not. The streams crossing this sandy belt are marked by narrow valleys and irregular profiles shown by the presence of rapids.

The lake expansions of the Seal are marked by sandy beaches. Chipewyan lake has a very irregular shoreline with long, narrow peninsulas of sand. It is paralleled by undrained lakes, undoubtedly remnants of a higher level of water when there was water connexion with Seal river. Between the lake expansions the current of the Seal is swift. Even at the rapid shown at the northern limit of the map it has not cut down to bedrock but flows over coarse boulders. Physiographically, the river is in the stage of youth.

The features which have been mentioned above in connexion with the topography of the region are all suggestive of a morainal origin, and the deposits are undoubtedly to be considered as part of a large terminal moraine left by the last continental ice-sheet which overrode the region. The nearest glacial striæ recorded are those from the northern end of Southern Indian lake where the movement was in a southwest direction approximately south 30 degrees west, a direction corresponding to the main trend of the Seal River sand ridges. It is considered that the deposits were laid down at the front of the melting age.

Melting at the southwestern border of the glacier front was faster than the advance from the northeast and deposition progressed rapidly giving rise to the typical rolling morainal topography (Figure 1). Many of the depressions and small lake-basins—which have been described above as being so characteristic a feature—are to be regarded as kettle-holes.

The absence of any sorted or stratified deposits is taken to mean that there was no body of water standing in front of the ice mass. No esker deposits were noticed. The narrow ridge between Little Sand and Trout lakes, which presents an esker-like appearance, consisted wholly of unsorted glacial materials of all kinds with huge erratics in places on the narrow summit of the ridge (Figure 2). The ridge is considered to be a lateral morainic deposit dropped along the side of an ice lobe. Material washed down from the ice lobe collected at the side, forming a steep, unsorted mass. On the melting of the ice the detritus on that side also came to rest at the angle of repose, forming a narrow, linear ridge. The ice front had probably many of these finger-like lobes forming lateral moraines more or less parallel to the direction of glaciation.

GENERAL GEOLOGY

The only outcrops observed along that part of Seal river explored, are at the south end of Chipewyan lake. Here a couple of small exposures of red granite gneiss project out on the shore from beneath the overlying morainal material. The unconsolidated deposits also consist mainly of detritus derived from granitic rocks, but since this material—probably to a large extent at least—was brought from a distance, little information regarding the rocks beneath the cover can be derived from it.

ECONOMIC GEOLOGY

The unsorted character of the gravel and sand deposits and their undoubted glacial origin makes the possibility of placer deposits being found in them obviously negligible. A type of deposit in the region reported to carry gold is a black sand which is best displayed on the shores of Chipewyan lake. Here a black border of magnetite sand has been left at the upper limit of wave action through the leaching out by the undertow of the lighter quartz and feldspar particles. This black border has a width in places of about a foot, and a few colours of gold can sometimes be obtained in a pan. A number of places where streams cut across the sand ridges were also examined and the gravels panned with negative results, in every case.

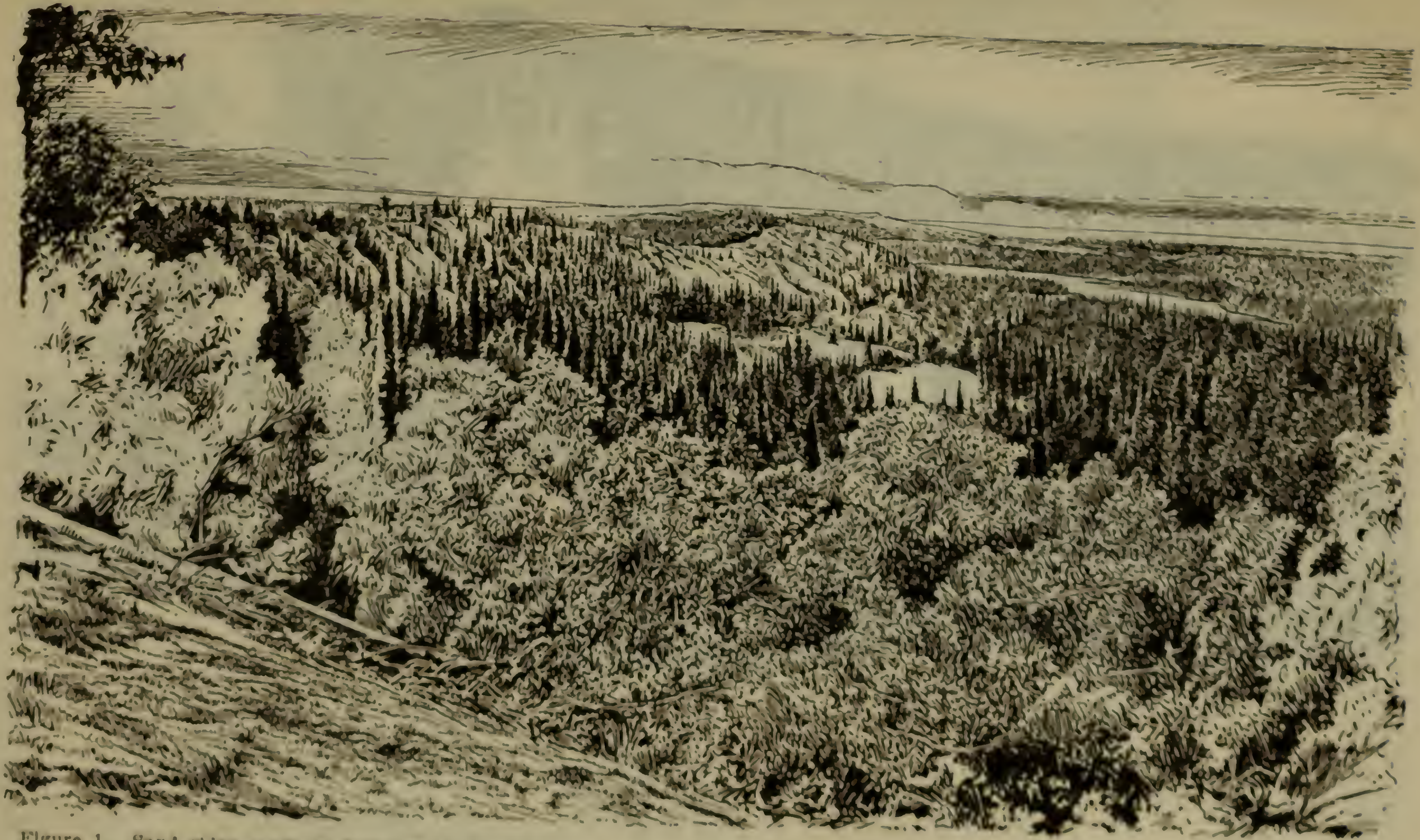

Figure 1. Sand ridge north of Little Sand lake, forming the divide between Seal and Churchill rivers. (Drawing by A. Miles, from an enlarged photograph.)

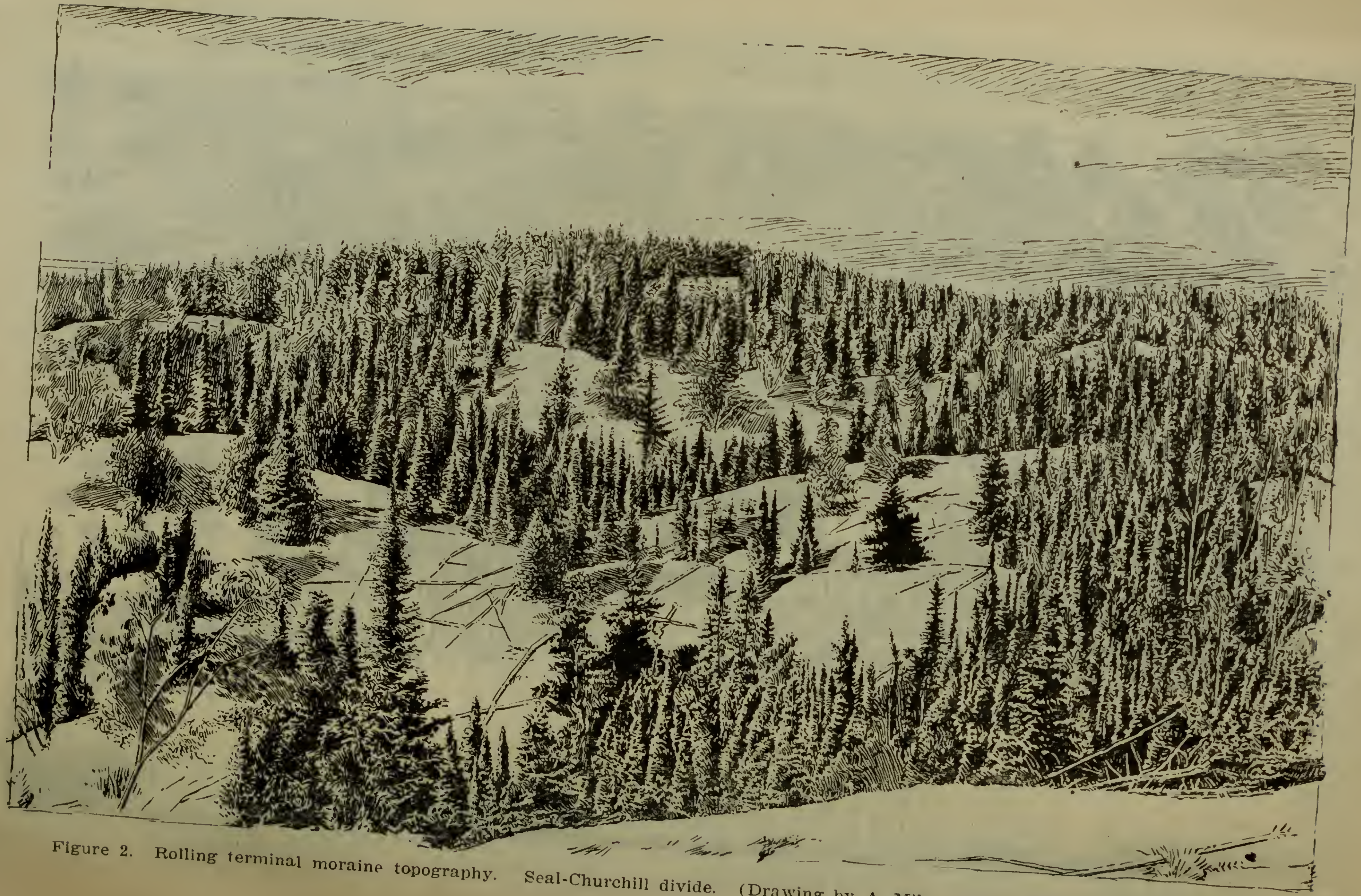

Figure 2. Rolling terminal moraine topography. Seal-Churchill divide. (Drawing by A. Miles, from an enlarged photograph.)

THE MASKWA RIVER COPPER-NICKEL DEPOSIT, SOUTHEASTERN MANITOBA

By W. S. McCann

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INTRODUCTION

The month of July, 1920, was spent in the investigation of the copper-nickel deposits near the headwaters of Maskwa (Bear) river in southeastern Manitoba. The field work was facilitated by co-operation with Dr. R. J. Colony of Columbia University, who kindly furnished data upon the petrographic character of the rocks of the district. Thanks are due also to Captain Ellice McDonald, M.D., Messrs. H. A. Smith, and D. S. McLeod, and others interested in the mining claims, for their hospitality and co-operation in carrying out the work. George W. Farmer rendered efficient assistance in the field.

The ore deposits lie in the northwest quadrant of tp. 19, range 14, E. of prin. mer., in southern Manitoba. The quadrant is 85 miles in an air-line northeast of Winnipeg, and 30 miles northeast of the village of Lac du Bonnet on the Canadian Pacific railway. The claims cover an area of approximately 15 square miles.

In spite of their proximity to navigable waterways and the railway, the claims are not easily accessible. From Winnipeg two routes are used, there being little choice between them. One route is as follows: Canadian Pacific railway to Lac du Bonnet. From that place runs a spur railway 14 miles long, on which there is an irregular service, to Grand du Bonnet falls, the journey usually being made by means of gasolene cars. From Grand du Bonnet (and in fact from Lac du Bonnet) Winnipeg river is navigable by canoes with few portages to the mouth of Maskwa river. Maskwa river is navigable by canoes from its mouth to Bear lake, 4 miles beyond Cat creek, on which stream the claims are situated. Between Winnipeg river and Cat creek there are twenty-two portages at low water, and eighteen when the water is high. From May landing, one-quarter of a mile below Cat creek, a good trail leads to the principal claims, it being 6 miles to the eastern or farthest edge of the mineralized area.

The other route is by Canadian National railways to Traverse bay, 4 miles south of Victoria Beach, thence by motor-boat to Fort Alexander, and by canoe to the mouth of Maskwa river; thence, as described in the first route, to the claims.

History of Discovery

The first claims were located by Amos May, A. C. McIntosh, and R. A. Hall on December 18, 1917. An Indian from Fort Alexander served as guide.

The topography of the Maskwa River district is similar to that of other parts of the Precambrian of Manitoba, in that it is characterized by low relief. Glaciation has levelled off what prominently upstanding topographic features may have existed in former geologic times, and the filling up of glacial depressions with muskeg has produced a generally featureless surface, now thickly overgrown with unburned timber and other vegetation.

The elevation of the region surrounding the claims is about 900 feet above sea-level, or about 200 feet above Winnipeg river at the mouth of the Maskwa. In detail the relief of the region rarely is above 75 feet. Small, rocky ridges extend discontinuously sometimes for a mile in length and usually lie in an east-west direction. The numerous rock outcrops rise above the muskeg as small islands. The densely growing timber combines with the muskeg to render overland travelling difficult.

Minor step-faulting in a general northeast-southwest direction has caused steep, roughly parallel cliffs 10 to 30 feet high. The freshness of the rock faces and their freedom from glacial striæ suggest post-glacial faulting.

The drainage of the district conforms with the drainage system of the entire region east of lake Winnipeg. Maskwa river is a meandering stream about 40 miles in length flowing eastward from Bear lake, and emptying into Winnipeg river 10 miles from its mouth. The level of its water is interrupted by numerous falls and rapids, there being twenty-six portages on its entire length. The inter-rapid reaches possess an almost imperceptible current except during the flood season, when a 4-mile-an-hour current often obtains. The width of the river is usually under 100 feet, and the banks are low-lying and of mud, except at the falls and rapids where the granite is exposed.

The tributary streams, such as Cat creek, are very small and of low gradient, and their courses include the most tortuous of meanders. They are navigable only for short distances. The water of the stream is of a dark brown colour due to included organic matter both dissolved and held in suspension.

Owing to the density of timber growth and the large areas underlain by muskeg, time did not permit the making of an accurate map. The base map[1] used was one prepared by the Mining Lands and Yukon Branch from information available May, 1920. It is only approximate and the department does not hold itself responsible for the correctness of the plan nor for the information contained therein.

The geological data have been plotted mainly from compass traverses, but where these do not coincide with the plan of the claims the geology has been adapted to the claim lines as far as has been possible. Local attraction, probably due to the presence of bodies of magnetite, has also militated against the accurate surveying of the area. The accompanying map (No. 1841) should, therefore, be accepted only as an illustration of the approximate inter-relationship of the various rock formations pending a more detailed examination in the future. The figures on the map represent claims the names of which are given on page 28.

GENERAL GEOLOGY

The predominant rocks in the district are the granites and associated granite gneisses. For the most part they are massive, light coloured rocks, but occasionally the foliation is distinct enough to render them faintly gneissic. They are undoubtedly batholithic in origin and have intruded the greenstone schist series, or in fact displaced them in this locality to such an extent that remnants only of the schists exist, probably as roof pendants.

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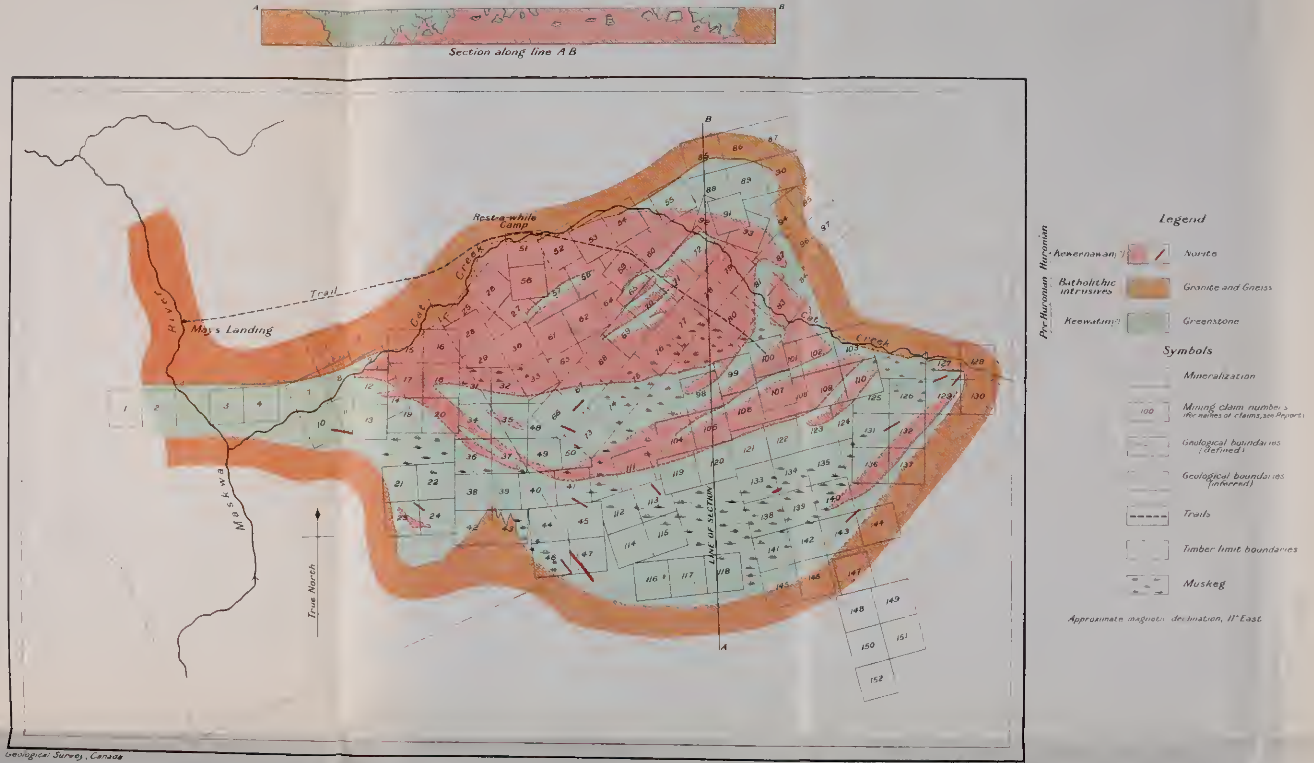
[1] Plan showing approximate position of mineral claims in Bear Lake district. Scale 40 chains to an inch.



Geological Survey, Canada

Publication Nº 1841

Diagram showing Maskwa River nickel-copper deposits, Manitoba

Scale of Miles

1 ¾ ½ ¼ 0 1 2

To accompany Report by W S McCann,
in Summary Report, Part C, 1920

The greenstone schists are dark coloured hornblendic rocks possessing distinct schistosity probably of Keewatin age, and are correlated with the Rice Lake series farther north. In the locality under discussion, such a remnant of greenstone nested in the granite has been a point of inherent weakness in the earth's crust, and the norite, following the line of least resistance, has intruded the greenstone, and in all probability, has assimilated a great part of it during the period of intrusion. No definite information was available for fixing the age of the norite, but it is believed to be the same as that of the Sudbury norite which is Keweenawan.

The norite is a dense, fine to coarse-grained granular igneous rock, greyish-black in colour. It has been the vehicle for bringing the ore, and has intruded the greenstones, and, to a small extent the granites in this locality in the form of a stock-like body and numerous dykes. It is probable that other bodies of norite having a common source will be found in the district.

Glaciation has uncovered the irregularly shaped roof of the norite stock in many places, leaving long belts of greenstone alternating with belts of norite.

Descriptions of Formations

Greenstone Complex. The greenstones and the norite are in the form of an elliptical inclusion in the granite and granite gneiss. Of this inclusion the greenstones comprise about 70 per cent and have their maximum development in the southern portion.

Another small belt of the greenstone complex cuts across Maskwa river half a mile below the last portage before coming to May landing. Distinct bedding is apparent, the strike being north 55 degrees west, and the dip 60 degrees south.

In some places the relationship of the two rocks is exceedingly intricate, and accurate geological mapping can be accomplished only with refined methods. They appear to grade into one another, and, in the field, distinction between the two is often based solely upon the schistosity characteristic of the greenstone.

In composition the greenstones are dark hornblendic schists having the appearance of metamorphosed dolerites or diabases. On the Imperial claim near the contact with the granite a peculiar structure was noted. Microscopic examination showed that it was probably an original orbicular structure partly obscured through metamorphism, which strengthens the opinion that the greenstones in this locality are dominantly of igneous origin.

Closely associated with the greenstones, and included with them in the geologic mapping, are smaller areas of metamorphosed sedimentary rocks in which a distinct bedding is still apparent. They are mostly intercalated hornblende schists and recrystallized quartzites.

In some places, near the contact with the norite, the greenstones hold numerous inclusions of labradorite feldspar crystals varying in size from ¼ to 3 inches in diameter, and usually spherical in shape. Differential weathering results in bringing the feldspar inclusions into knobby, white relief. This rock indicates strikingly the force of injection phenomena attending the intrusion of the norite.

Lithologically these rocks resemble the Rice Lake series on Oiseau lake[1], but no conglomerate nor ellipsoidal greenstone was noted within the area under discussion. The greenstone complex is, therefore, correlated with the Rice Lake series lying to the northeast which are of probable Keewatin (Pre-Huronian) age.

Granite and Granite Gneiss. By far the most predominating rocks in the district are granite and granite gneiss. In the locality herein described these rocks almost entirely surround the greenstone and norite area, and display few variations in character. In colour they are usually pink or grey, the darker varieties possessing notable amounts of accessory biotite or hornblende.

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[1] Moore, E. S., Geol. Surv., Can., Sum. Rept., 1912, p. 264.

> According to Colony[1] "the most striking feature shown microscopically is the marked inequigranular aspect of the rock which carries numerous hypidiomorphic microcline crystals with crenulated margins, ranging from one-half to one centimetre in size and surrounded with much smaller grains, which give the rock a pseudo-porphyritic texture. There is also, in numerous other grains, a strong tendency towards micrographic intergrowths on a very minute scale."

The granite and granite gneiss appear to grade into one another and could not be differentiated easily in the field. The granite gneiss, in the vicinity of the claims has not generally a conspicuous gneissoid texture, thereby differing from the granite gneiss outcropping lower down Maskwa river.

The contact of the granite with the enclosed rocks illustrates clearly the intrusive character of the granite into the greenstone, and the older relations of the granite to the norite.

Maskwa River Norite.[2] The following petrographic description of the norite by Dr. R. J. Colony[3] agrees with the present writer's observations:

> "The norite is of simple composition, but varies both in texture and mineral make-up to some degree because of differentiation. In general it is composed almost wholly of basic feldspar ranging from andesine to labradorite, and carries as the only ferromagnesian component a green amphibole, or actinolite, derived by uralitization from a former magnesian pyroxene, probably hypersthene. One of the most striking features of the rock is the manner in which the uralitized pyroxene encroaches upon, cuts through, and penetrates the feldspar (which is otherwise perfectly fresh and unaltered) in every conceivable direction; it is clearly a product of the action of magmatic end-phase-consolidation matters upon an original containing both magnesia and iron, i.e., hypersthene.
>
> "The feldspars have not been affected in any other way; they are hypidiomorphic, with crenulated margins, showing granulation along the borders in some cases, with wedge-twinning, bent grains, and micro-faulting.
>
> "The ore minerals are magnetite, ilmenite, pyrrhotite, and chalcopyrite, all closely associated and intergrown. So far as a time relation can be made out they are all of late magmatic stage, essentially almost contemporaneous, but overlapping, so that the earliest are magnetite and ilmenite, the next pyrrhotite and the latest chalcopyrite, with replacing effects on one another in the order named.
>
> "They occur in blebs, in irregular patches, stringers and veinlets, lying in, surrounding, cutting and replacing the silicate minerals of the rock, and penetrating cleavages; their mode of occurrence and the manner in which they are associated with the silicate minerals clearly indicate that these ore minerals were formed later than but immediately following the magmatic alteration of the original pyroxene to uralite, thus placing them very definitely in a late magmatic stage."

Evidence as to the stock-like character of the intrusive is found in the coarseness of grain of the norite in places, and the nature of the dips at the contact with the surrounding intruded granite and greenstone, the dip generally being away from the norite body. On the Helen claim the norite is exceedingly coarse grained, being made up almost entirely of labradorite individuals possessing nearly perfect crystallization lying in a matrix of fine-grained ferromagnesian minerals. Dynamic metamorphism has resulted in the fracturing of the feldspars and the mashing and recrystallization of the ferromagnesian minerals. Striking features of the norite are its fresh appearance and the absence of alteration by hydrothermal solutions.

---

[1] Colony, R. J. "A norite of the Sudbury type in Manitoba." Bull. 103, C.I.M.M., Nov., 1920, p. 867.

[2] The name Maskwa River norite was given by Dr. R. J. Colony in his paper "A norite of the Sudbury type in Manitoba." Bull. 103, C.I.M.M., Nov., 1920, pp. 862-872.

[3] Idem.

Pegmatite Dykes. Cutting the norite and the greenstone are numerous pegmatite dykes, in places containing mica and magnetite. It is believed that they represent the extreme end-phase of the norite magma and that they were intruded immediately after the norite had solidified.

ECONOMIC GEOLOGY

The mining claims cover nearly all of the country underlain by the norite and greenstone. Even parts covered by muskeg have been staked, although no rock outcrops are visible.

Summary investigation has revealed only two types of mineral deposits, as follows:

(1) Mineralized norite near the contacts with other rocks; or marginal deposits.

(2) Mineralized norite not adjacent to the contacts with other rocks.

The distinction between these types is purely a field one, and development may prove the deposits to be virtually of the same type, i.e., marginal deposits; since the writer believes that on account of the small amount of erosion of the norite, all parts of the norite now exposed are not far removed from the original upper contact of the norite stock (See structure section in Figure 3.)

In both types (if, indeed there are two) the mineralization is the same. The metallic minerals pyrrhotite, pentlandite, and chalcopyrite occur as blebs and small masses throughout the norite, cutting and replacing the silicate minerals in such a manner as to indicate that they were formed later than the silicate minerals but during the period of intrusion and solidification of the norite.

Figure 4 shows the inter-relationships between the sulphides, the paragenesis of the minerals being pyrrhotite, pentlandite, chalcopyrite, in the order named. This order corresponds with that of the sulphides at Sudbury.[1] The close association of the pentlandite, the nickel-bearing mineral, with the pyrrhotite is of particular importance. The selective replacement of the ferromagnesian minerals of the norite by the sulphides is illustrated in Figure 5, but it is to be borne in mind that the sulphides also occur cutting across, and included in, some of the feldspar crystals.

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[1] Trans. Am. Inst. Min. Eng., vol. 59. 1918, p. 41.

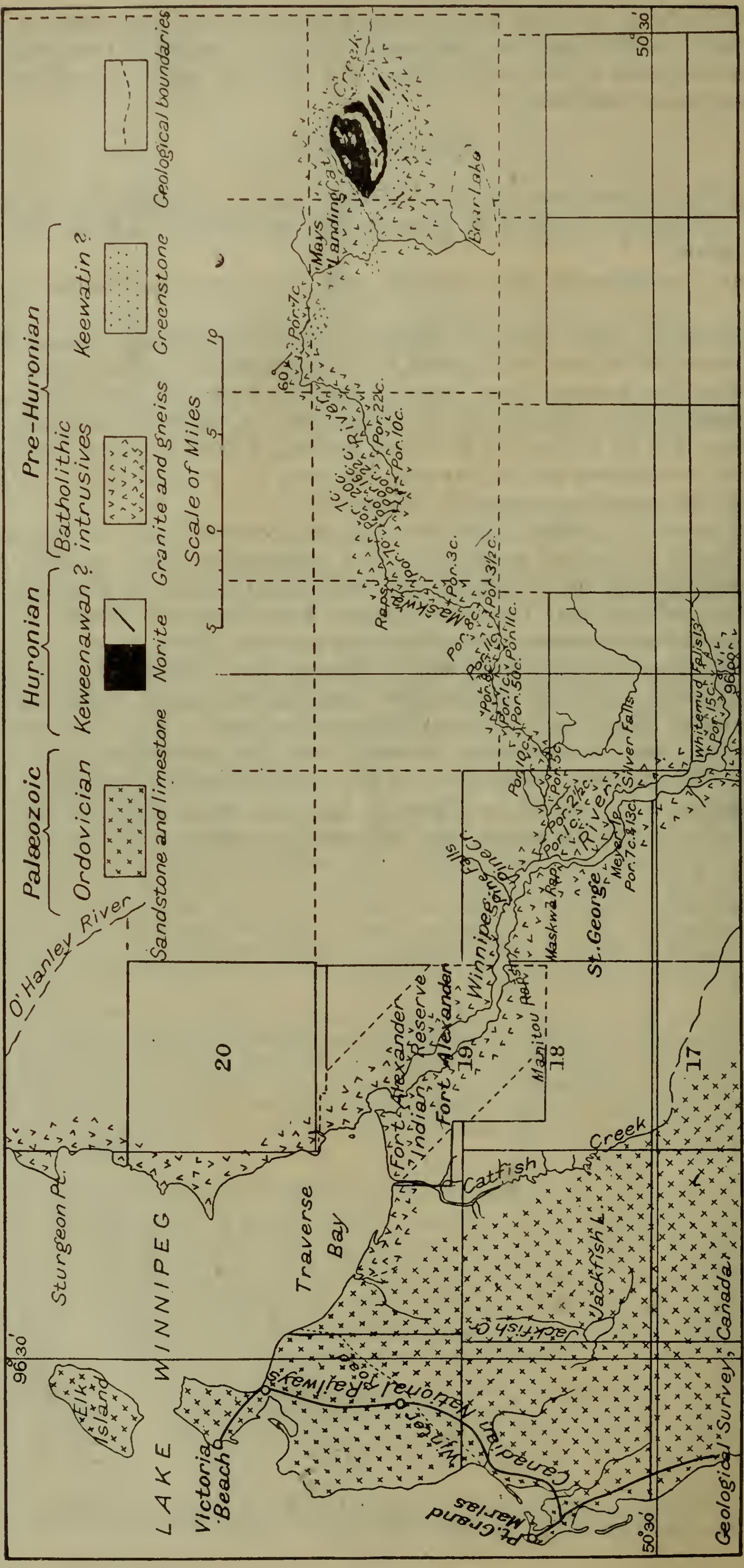
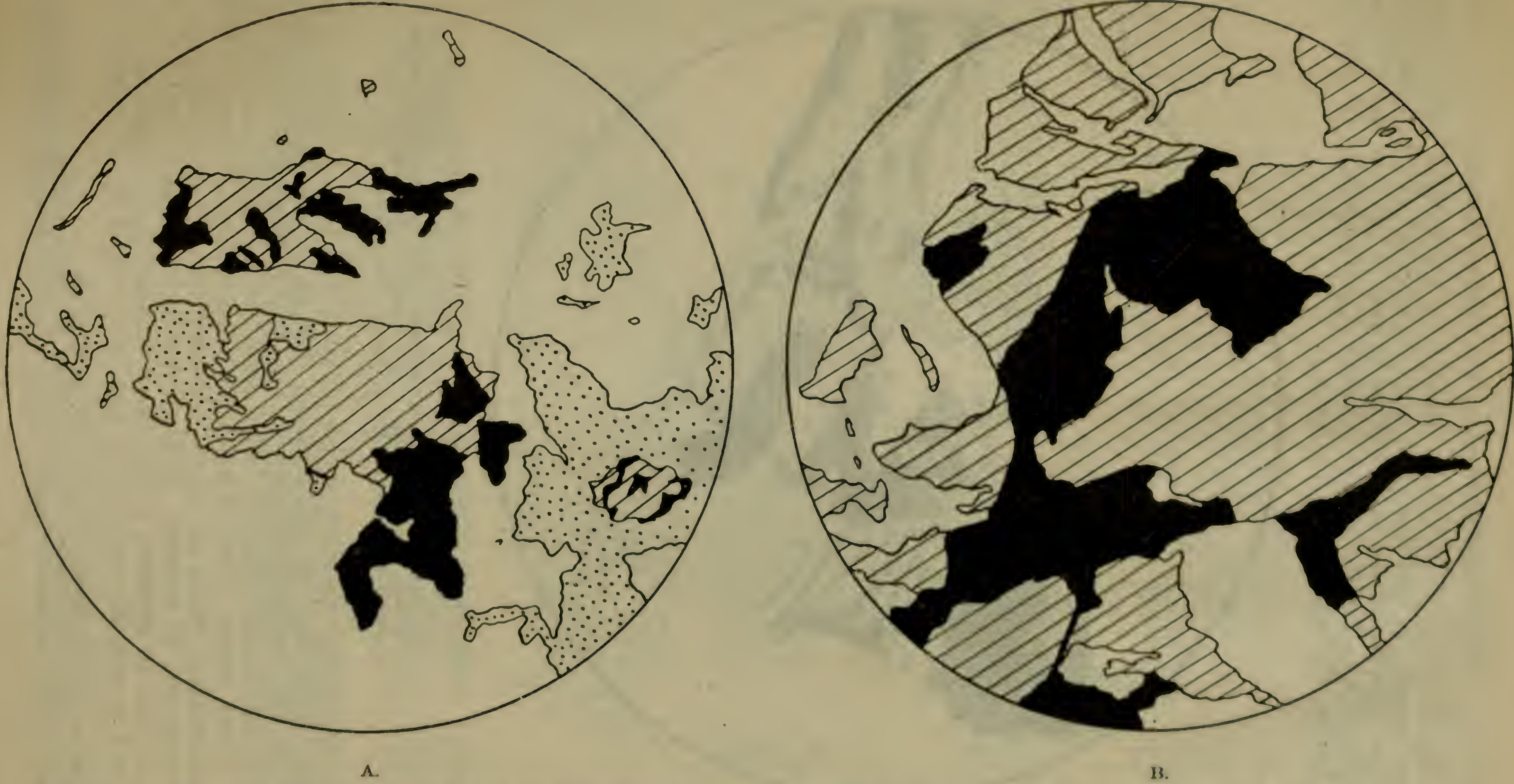


Figure 3. Maskwa river, Manitoba, geological diagram showing location of nickel-copper deposits.



A.

B.

Figure 4. Camera lucida drawings (magnification 20 diameters) of polished specimens of ore from the Hititrite claim, showing the inter-relationship of the metallic minerals. A—black areas, pentlandite; dotted areas, chalcopyrite. B—Black areas, pentlandite; hatched areas, pyrrhotite; white areas, gangue minerals.

Origin and Persistence of the Mineral Deposits

The igneous origin of the metallic minerals of the Sudbury deposits has been made clear through the investigation of various geologists,[1] and the examination of thin sections and polished sections under the microscope indicates that the Maskwa River deposits are analogous with those of Sudbury, and emphasizes the genetic relationship between the sulphides and the norite.

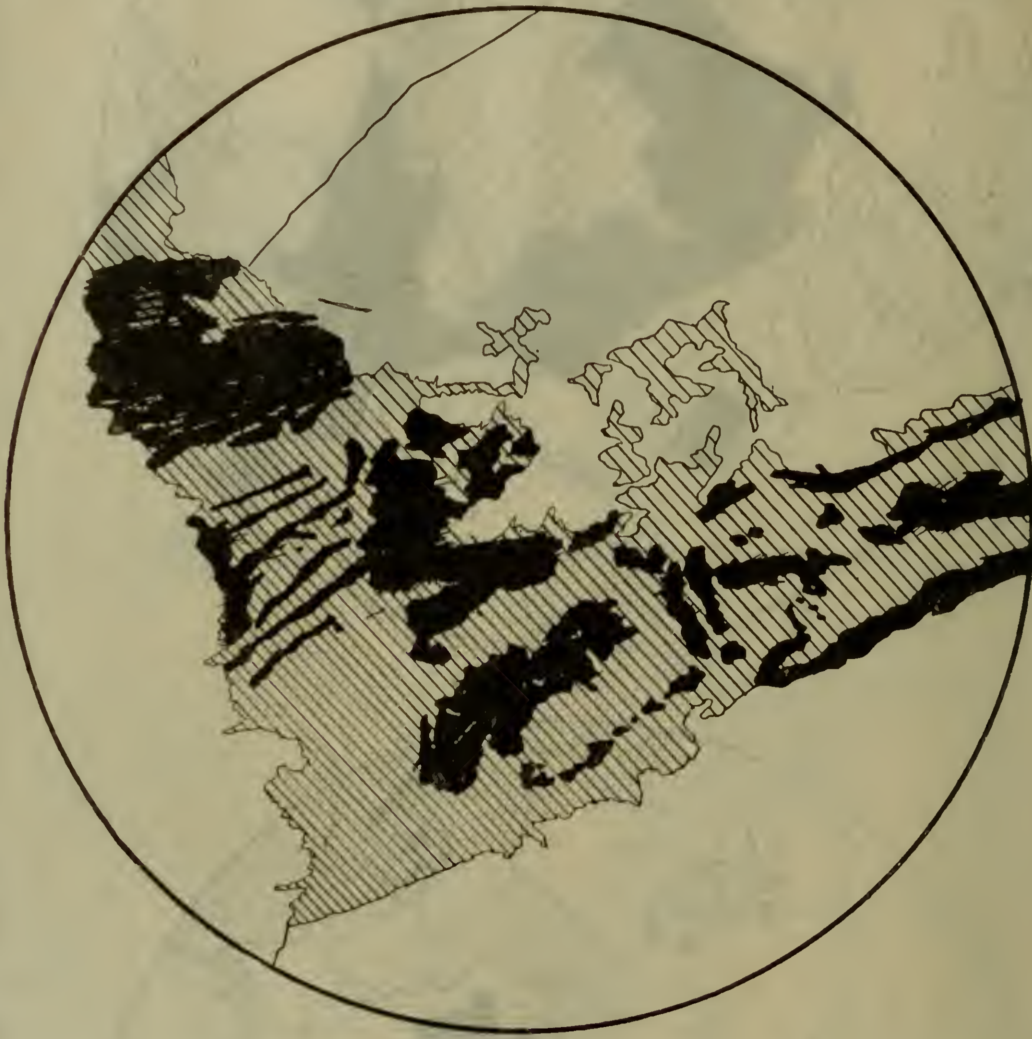


Figure 5. Camera lucida drawing (magnification about 18 diameters) of section of norite from the Helen claim showing selective replacement of ferromagnesian minerals (hatched areas) by metallic minerals—in this case pyrrhotite (black areas). The feldspars (white areas) have not lent themselves to replacement.

It is believed that the norite during its intrusion into the greenstone complex, underwent differentiation in such a manner that the ferromagnesian minerals and the sulphides were segregated along the margins of the intrusive while the more acidic portions of the magma remained in the central portions, which have not yet been exposed through erosion. The end-facies of the differentiation, however, is shown in the pegmatite dykes cutting the norite. The acidic portions would correspond with the micropegmatite of Sudbury. During a late stage in the consolidation of the magma the minerals effected a rearrangement whereby the ferromagnesian minerals were altered to actinolite and then in part were replaced by the sulphides. The stresses accompanying the consolidation and rearrangement of the minerals resulted in the fracturing of the silicates which may have just crystallized and permitted of the injection of the sulphides along minute planes of fracture.

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[1] Barlow, A. E., Geol. Surv., Can., vol. XIV, pt. H, p. 126.
Coleman, A. P., Dept. of Mines, Mines Branch, "The nickel industry," 1913, p. 29.
Roberts, H. M., and Longyear, R. D., Trans. Am. Inst. Min. Eng., vol. 59, 1918, p. 56.

Little work has been done on the claims beyond "surface stripping" so that no information regarding the mineral deposits at depth is available. However, from the similarity of the deposits to those of Sudbury in mineralization and geological association, certain inferences may be drawn with reasonable security, as follows:

Ore deposits are likely to occur in the norite adjacent to the main contacts with other rocks as marginal deposits. In the field faint mineralization was observed near such contacts, and diamond drilling at these localities may reveal ore-bodies.

Marginal ore-bodies adjacent to main contacts are more apt to be persistent at depth than those found scattered across the broad surface of the exposed norite.

The amount of nickel in the ore is in some direct proportion to the amount of pyrrhotite.

Value of the Ore

The following table gives the grade of ore determined by assays of samples of mineralized norite collected at the surface. An average assay of ore from Sudbury is included for comparison. In 1913 under the existing conditions of roasting and smelting at Sudbury the actual amounts of nickel and copper recovered were estimated to be from 80 to 90 per cent of the metals in the ores.[1]

	I	II	III	IV	V	VI	VII	VIII
	%	%	%	%	%	%	%	%
Copper..........	1·35	0·27	3·23	0·68	1·84	1·07	0·16	2·12
Nickel..........	none	0·19	0·59	1·68	0·36	0·40	0·15	3·09
Gold..........	trace	trace	....	....	....	trace	trace	....
Platinum..........	none	none	0·02	0·01	0·03	none	none	....

I. From Chinook claims. Analyst A. Sadler, Dept. of Mines, Canada.
II. From Hititrite claim. Analyst A. Sadler, Dept. of Mines, Canada.
III. From Hititrite claim, collected by R. J. Colony. Analyst A. Ledoux & Co.
IV. From Hititrite claim, collected by R. J. Colony. Analyst A. Ledoux & Co.
V. From Nova claim, collected by R. J. Colony. Analyst A. Ledoux & Co.
VI. From Mayville claim. Analyst A. Sadler, Dept. of Mines, Canada.
VII. From Copper Dome claim. Analyst A. Sadler, Dept. of Mines, Canada.
VIII. From Sudbury. Calculated average of metals in the ore.

Physical Characters of the Metallic Minerals[2]

Pyrrhotite. Iron sulphide, sometimes called magnetic pyrites. Colour bronze-white to bronze-yellow, subject to speedy tarnish. Hardness 3·5 to 4·5, can be scratched by steel. Lustre metallic, magnetic.

Pentlandite. A sulphide of iron and nickel (Fe Ni) S. Sulphur 36·0 per cent. Iron 42·0 per cent. Nickel 22·0 per cent. Fracture uneven, brittle. Colour light bronze-yellow. Hardness 3·5-4. Can be scratched with steel. Lustre metallic, not magnetic.

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[1] Coleman, A. P., loc. cit., p. 108.
[2] From Dana's "Text book of mineralogy."

Chalcopyrite. A sulphide of copper and iron having the composition $CuFeS_2$ or $Cu_2S.\ Fe_2S_3$. Sulphur 35·0 per cent. Copper 45·5 per cent. Iron 30·5 per cent. Fracture uneven. Brittle. Hardness 3·5-4·5. Lustre metallic. Colour brass-yellow, often tarnished or iridescent.

List of Claims[1]

1. Black Bear
2. Black Rock
3. No. 9
4. Big Mosquito
5. Archie
6. Joe
7. Florence
8. Cat Creek
9. Copper Dome
10. El Paso
11. Hudson
12. Native Copper
13. Kimberley
14. Grey Copper
15. Consolidated
16. Smuggler
17. Atcheson
18. Rio Tinto
19. Arizona
20. Copper Cliff
21. Peck
22. Topeka
23. Minot
24. Leo
25. Robina
26. Stella
27. Ohio
28. Nova
29. Terra
30. Cork
31. Bornite
32. Black Diamond
33. Calumet
34. Cleveland
35. Iowa
36. Butte
37. Montana
38. Silena
39. Bodega
40. Ford Adanac
41. Ester
42. Lucy
43. Osage
44. Dunbar
45. Edith
46. Dina
47. Hassel
48. B. B.
49. Copper King
50. Copper King No. 2
51. Bowyang
52. Mary
53. Karen
54. Lily
55. Bertha
56. Norite
57. Copper Mountain
58. Anaconda
59. Ora
60. Gilroy Fn.
61. Belfast
62. Pronto
63. Anaconda Fn.
64. Hecla
65. Mayville Fn.
66. Atlantean
67. Butte
68. Emily
69. Herbert
70. Mayville
71. Gilroy
72. K. C.
73. Bear
74. Anaconda South
75. Box
76. Minnie
77. Margaret
78. Helen
79. Lewis
80. Strathcona
81. Northern
82. Dore.
83. Copper Belle
84. Elsie
85. Mina
86. Nitram
87. Little Glen
88. Eureka
89. Eleanor
90. Isabel
91. Tim
92. Jemima
93. Contact
94. Buck
95. Winner
96. Kura
97. Jack Pot
98. Copper Bottom
99. Veni
100. Hititrite
101. Mother Lode Fn.
102. Chalco
103. Copper Queen No. 1
104. Caribou
105. Copper Contact
106. Canada
107. Verifair
108. Mammoth Fn.
109. Vidi
110. Copper Queen
111. Troy
112. Frisco
113. Santa Fe
114. Kipp
115. Teton
116. Mack
117. Mick
118. Mike
119. Moose
120. Emma
121. Madison
122. Mother Lode No. 1
123. Mother Lode
124. Rakie
125. Olsen.
126. Hat
127. Empress
128. Bali
129. Jefferson
130. Helie
131. Bob.
132. Rhodes
133. Chinook
134. Chateau
135. Havre
136. Prince
137. Tony
138. Yosemite
139. San Jose
140. Grainger
141. Roy
142. Allan
143. Florida
144. Tampa
145. Kelly
146. Irvine
147. May
148. Sydney
149. Loraine
150. Bear Lake
151. Little Bear Creek
152. Vemy

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[1] NOTE.—The list includes most of the claims staked up to July, 1920. The numbers correspond with those on Map 1841, which shows their approximate location.

Other Nickel-copper Deposits of the Region

Recently the discovery of other ore deposits has been reported from this region. On the Oiseau (Bird) river, 2 miles east of Oiseau lake,[1] ore deposits are said to occur in norite of a coarser grain than the Maskwa River norite. A sample of pyrrhotite-pentlandite ore collected by William Martin, jun., upon analysis by Ledoux & Co., gave the following results:

Insoluble siliceous matter	44.76%
Iron	28.50
Nickel	2.92
Copper	0.08
Cobalt	trace
Lead	0.03
Alumina	1.50
Arsenic	trace
Zinc	trace
Silver	trace
Gold	0.01 oz.
Platinum metals	none

A sample containing 5·85 percentage nickel is reported by E. V. Neelands from the Oiseau Lake vicinity. No detailed information is at hand regarding the geological relationships of these newly discovered deposits.

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[1] Map 96A (1913), Dept. of Mines, Geol. Surv., Can., Oiseau lake lies just off the southeastern corner of Map 1841.

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The annual Summary Report of the Geological Survey is issued in parts, referring to particular subjects or districts, and each designated by a letter of the alphabet. A review of the work of the Geological Survey for the year with lists of reports and maps published during the year, forms part of the Annual Report of the Department of Mines.